

Remarks/Arguments

Attorney for Applicant submits this Amendment to further distinguish the claimed invention from the prior art of record and to place the present application in condition for allowance. Such action is respectfully solicited.

Claims 71 to 167 remain in the subject application. New Claim 168 has been introduced.

The Examiner has objected to Claims 100-131 based on the contention that the preamble of these Claims indicates that they are directed to a catalyst composition but the substance of the claim is directed to process steps. The Examiner suggests that Claims 100-131 be cancelled, or amended to be made dependent on independent process claim 162 or be rewritten in independent form.

It is respectfully submitted that the present invention is properly defined by:

- Product-by-process Claims 71-132 wherein the catalyst composition is "formed by contacting substantially simultaneously in a single reaction zone and in an inert liquid" the defined components a), b) and c). The exact nature of the catalyst composition, once the components a), b) and c) have been contacted together is not readily identifiable and therefore, properly defined in product-by-process claim format.
- Product Claims 133 to 161 directed to a mixture of components a), b) and c) irrespective of how formed. These claims define

the initial mixture of components a), b) and c) and may also define the resultant product.

- Process Claims 162 to 168 directed to a process of forming the subject catalyst composition.

It is respectfully submitted that Claims 100-131 properly aid in defining and further limiting independent product-by-process Claim 71.

Independent Claim 71 requires the three defined components to be contacted "substantially simultaneously". The Examiner cites Merriam-Webster dictionary definition of the term "simultaneous" as an act that occurs at the same time. However, the claim term is "substantially simultaneously" which is taught to refer to contacting the three components in a rapid or an uninterrupted manner either by concurrent or uninterrupted sequential introduction into a single reaction zone.

In view of the Examiner's suggestion, Claims 72 and 73 have been amended to more clearly indicate that "precatalyst" and "transition metal compound" both refer to component c) defined in Claim 71.

The Examiner has rejected Claims 72, 73, 134 and 135 in view of the term "anionic ligand group" as used in section (iii) of each claim. The claims have been amended to fully overcome this rejection. Withdrawal of the rejection is solicited.

The Examiner has rejected certain indicated claims under 35 USC 102 (a) over the teaching of Bennett (US Patent 5,955,555), Mackenzie, et al. (US Patent 6,303,720) and Ponasik, et al. (US Patent 6,365,539). It is respectfully submitted that the presently claimed invention is distinct from and not

suggested by the cited teachings. Each of the rejections should be withdrawn.

For clarification purposes, Applicant wishes to aid the Examiner by describing certain unique features of the presently claimed invention over that of the known art.

The present invention is directed to a supported catalyst composition. Applicant acknowledges that the defined aluminum compound has been used as cocatalyst/activator in other catalyst compositions; that inorganic oxides, such as silica and alumina materials, have been used as supports in other catalyst compositions; and that bi-and/or tri-dentate transition metal complexes have been used as precatalyst in other catalyst compositions. However, it is respectfully submitted that the presently claimed highly active catalyst composition is not disclosed nor suggest by the prior art.

The prior art teaches that Lewis acid compounds are useful as cocatalyst/activator for bi- and tri-dentate/transition metal complex pre-catalysts. However, when forming a supported catalyst of such components, those skilled in the art deem it necessary to combine the precatalyst with a strong Lewis acid co-catalyst compound (such as difficult to handle MAO or costly borane compounds). The short comings of such co-catalysts are fully discussed in the background section of the present application. In order to provide or enhance the activity when a weak Lewis acid activator is used, it has been standard practice to i) use large quantities of such weak Lewis acid compounds relative to the transition metal precatalyst and/or ii) augment the weak Lewis acid with one of the strong Lewis acid compound described

above. None of the above systems provides a commercially desirable means of attaining an active catalyst composition.

It is further known and recognized that inorganic oxides, such as silica, alumina and like, are useful materials in forming supported catalyst compositions. The choice of such material is large as many different inorganic oxides are commercially available. When such systems are desired, it is conventional to initially impregnate the support with either a pre-catalyst or co-catalyst of choice to initially form an intermediate support material. This isolated material is subsequently contacted with the other component, usually in the polymerization zone.

What is distinct in the present invention is that a supported catalyst can be formed by substantially simultaneously contacting defined components a), b) and c). The component a) is reserved to certain weak Lewis acid aluminum compounds (normally used in large amounts or augmented by strong Lewis acid compound) used in very low molar ratio of aluminum of a) to transition metal of c) of from 1:1 to 25:1. This is counter to that taught by the prior art. The component b) is restricted to inorganic oxides having very low surface hydroxyl groups. The large number of commercially available inorganic oxides do not have this property as an inherent feature. Such feature is not standard with respect to commercial product. Even if, arguendo, such material can be commercially obtained, there is no teaching which directs the artisan to use this particular material as the required support.

Thus, the presently claimed invention requires certain specific co-catalyst and support components with properties and in amounts not taught

by the cited art. Applicant has unexpectedly found that a highly active catalyst composition (one capable of forming commercially desired high molecular weight polymer instead of undesired low molecular weight oligomer product) can be achieved when the defined components are substantially simultaneously contacted together in certain claimed ratios.

With respect to Bennett, it is recognized that this reference teaches various aluminum compounds as useful. The illustrative examples of Bennett show that MAO is the activator of choice when preparing supported catalyst compositions. Further, Bennett teaching, at Col. 10, l 41-49, supports prior art's thinking with respect to Applicant's aluminum component [component a)]. Further, Bennett does not teach or suggest the use of any particular support, as presently required. All silica and alumina compounds deemed useful as supports do not inherently have the presently required property.

With respect to Mackenzie et al., this reference, like Bennett, teaches a wide variety of Lewis acid compounds suitable as co catalysts. Mackenzie et al. teaches that such compounds need to be capable of abstracting the anionic specie Q^- or W^- of the precatalyst and, by their illustrative examples, show that MAO and the like are preferred. There is no teaching of the presently claimed specific properties for the inorganic oxide. The Examiner's contention that such properties are inherent in all commercially available materials is not supported nor correct.

With respect to Ponasik et al., the same comments as made above with respect to Bennett and Mackenzie et al., are applicable to this reference.

It is well recognized that catalytic chemistry is an unpredictable art and general teachings can not be deemed to teach nor make obvious a specific

combination unexpectedly found to achieve desired high catalytic activity capable of forming high molecular weight product. This is especially so when the amount and type of certain components are contrary to such general and established teaching. For this reason, it is respectfully submitted that the references do not support the present rejections of the claims. Withdrawal of these rejections are solicited.

The Examiner has rejected all of the claims presently under consideration over the claims of U.S. 6,686,306; U.S. 6,559,090; U.S. 6,399,535; and U.S. 6,184,171. It is respectfully submitted that these rejections are not appropriate with respect to the present application and should be withdrawn.

The present application claims priority to U.S. Serial No. 09/431,803 having a filing date of November 1, 1999, a date which is earlier than or the same as the filing dates of U.S. '306; U.S. '090; and U.S. '535. Thus, the patent term for any patent granted from the present application would be earlier than or the same as that of these cited patents. The judicial doctrine of double patenting is not applicable in such instance.

With respect to U.S. 6,184,171, this cited reference is directed to a catalyst material having the catalyst moiety connected to a support material by an organo chain. The referenced claims are distinctly different from that of the present claims. It is respectfully submitted that the presently claimed invention should not be subject to the judicial doctrine of double patenting with respect to US '171.

Withdrawal of the double patenting rejections is solicited.

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Applicant believes that the presently claimed invention is patentably distinct from the cited art and that the application is in condition for allowance. Such actions is respectfully solicited.

Respectfully submitted,

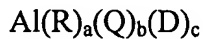
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IN THE CLAIMS:



71. (currently amended) A catalyst composition useful in the polymerization of olefins formed by contacting substantially simultaneously in a single reaction zone and in an inert liquid, the components comprising:

a) aluminum compounds selected from at least one aluminum compound represented by the formula



wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen;

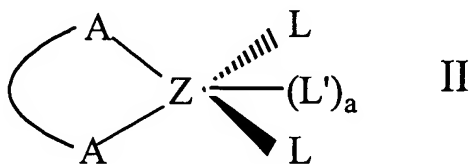
and each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/transition metal complex, a tridentate ligand/transition metal complex and mixtures thereof and wherein the transition metal of said complex is Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr or Hf;

said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μmol of transition metal per gram of inorganic oxide and a mole ratio of aluminum of component a) to transition metal of component c) of from 1:1 to 25:1.

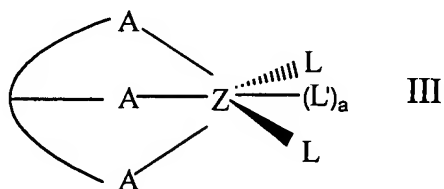
72. (currently amended) The catalyst composition of Claim 71 wherein the precatalyst is a transition metal compound comprising at least one~~is a~~ bidentate ligand/transition metal complex represented by the formula



wherein

- i) each A independently represents an oxygen, sulfur, phosphorus or nitrogen atom of the bidentate ligand;
- ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr and Hf in the +2, +3 or +4 oxidation state;
- iii) each L and L' independently represents ~~an anionic~~ a ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z, represents a C₃-C₂₄ hydrocarbylene metallocyclic structure; and
- iv) "a" of (L')_a is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

73. (currently amended) The catalyst composition of Claim 71 wherein the precatalyst is a transition metal compound comprising at least one~~is a~~ tridentate ligand/transition metal complex represented by the formula



wherein

- i) each A independently represents an oxygen, sulfur, phosphorus or nitrogen atom of the tridentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr, and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L' independently represents ~~an anionic~~ ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z represents a C₃-C₂₄ hydrocarbylene metallocyclic structure; and

iv) "a" of (L')_a is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

74. (previously presented) The catalyst composition of claim 72 or 73 wherein each A represents a nitrogen atom, each L and L' is independently a halogen atom, or a hydrocarbyl or mixtures thereof or both L together form a hydrocarbylene metallocyclic group which, with Z, forms a 3 to 7 member ring structure.

75. (previously presented) The catalyst composition of Claim 72 or 73 wherein "a" of the aluminum compound is 1 to 3 and each L of the transition metal compound is a halogen atom.

76. (previously presented) The catalyst composition of Claim 72 or 73 wherein at least one L of the transition metal complex is hydrocarbyl.

77. (previously presented) The catalyst of Claim 71 wherein Z is Ni, Pd, Fe or Co.

78. (previously presented) The catalyst composition of Claim 72 wherein Z is Ni or Pd and each L is independently chlorine, bromine, iodine or a C₁-C₈ alkyl group.

79. (previously presented) The catalyst composition of Claim 73 wherein Z is iron or cobalt and each L is independently chlorine, bromine, iodine or a C₁-C₈ alkyl group.

80. (previously presented) The catalyst composition of Claim 71 wherein "a" of the aluminum compound is 3.

81. (previously presented) The catalyst composition of Claim 72 wherein "a" of the aluminum compound is 3.

82. (previously presented) The catalyst composition of Claim 73 wherein "a" of the aluminum compound is 3.

83. (previously presented) The catalyst composition of Claim 74 wherein "a" of the aluminum compound is 3.

84. (previously presented) The catalyst composition of Claim 71 wherein the transition metal is Fe.

85. (previously presented) The catalyst composition of Claim 72 wherein the transition metal is Fe.

86. (previously presented) The catalyst composition of Claim 73 wherein the transition metal is Fe.

87. (previously presented) The catalyst composition of Claim 80, 81 or 82 wherein the transition metal is Fe.

88. (previously presented) The catalyst composition of Claim 71 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

89. (previously presented) The catalyst composition of Claim 80 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

90. (previously presented) The catalyst composition of Claim 81 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

91. (previously presented) The catalyst composition of Claim 82 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

92. (previously presented) The catalyst composition of Claim 83 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

93. (previously presented) The catalyst composition of Claim 84 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

94. (previously presented) The catalyst composition of Claim 85 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

95. (previously presented) The catalyst composition of Claim 86 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

96. (previously presented) The catalyst composition of Claim 87 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

97. (previously presented) The composition of Claim 71, 80, 81, 82 or 88 wherein the inorganic oxide is silica and the transition metal is Fe.

98. (previously presented) The catalyst composition of Claim 71, 80 or 88 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

99. (previously presented) The catalyst composition of Claim 97 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

100. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein the components are sequentially introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

101. (previously presented) The catalyst composition of Claim 74 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

102. (previously presented) The catalyst composition of Claim 75 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

103. (previously presented) The catalyst composition of Claim 76 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

104. (previously presented) The catalyst composition of Claim 83 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

105. (previously presented) The catalyst composition of Claim 84 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

106. (previously presented) The catalyst composition of Claim 85 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

107. (previously presented) The catalyst composition of Claim 92 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

108. (previously presented) The catalyst composition of Claim 93 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

109. (previously presented) The catalyst composition of Claim 94 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

110. (previously presented) The catalyst composition of Claim 97 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.

111. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

112. (previously presented) The catalyst composition of Claim 74 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

113. (previously presented) The catalyst composition of Claim 75 wherein components a), b) and c) are concurrently introduced into the inert liquid and

maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

114. (previously presented) The catalyst composition of Claim 83 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

115. (previously presented) The catalyst composition of Claim 84 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

116. (previously presented) The catalyst composition of Claim 85 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

117. (previously presented) The catalyst composition of Claim 92 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

118. (previously presented) The catalyst composition of Claim 93 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

119. (previously presented) The catalyst composition of Claim 94 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

120. (previously presented) The catalyst composition of Claim 97 wherein components a), b) and c) are concurrently introduced into the inert liquid and maintained therein at temperatures of from 0° to 50° C and atmospheric pressure.

121. (previously presented) The catalyst composition of Claim 71, 72, 73, 77, 78, 79, 80, 81, 82, 86, 88, 89, 90 or 91 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

122. (previously presented) The catalyst composition of Claim 74 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

123. (previously presented) The catalyst composition of Claim 75 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

124. (previously presented) The catalyst composition of Claim 76 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

125. (previously presented) The catalyst composition of Claim 83 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

126. (previously presented) The catalyst composition of Claim 84 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

127. (previously presented) The catalyst composition of Claim 85 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

128. (previously presented) The catalyst composition of Claim 92 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

129. (previously presented) The catalyst composition of Claim 93 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

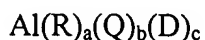
130. (previously presented) The catalyst composition of Claim 94 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

131. (previously presented) The catalyst composition of Claim 97 wherein the components a), b) and c) are directly introduced into an olefin polymerization reaction zone.

132. (previously presented) The catalyst composition of Claim 84, 85 or 86 wherein "a" of the aluminum compound is 3.

133. (previously presented) A heterogeneous catalyst composition useful in the polymerization of olefins comprising a mixture of:

a) aluminum compounds selected from at least one aluminum compound represented by the formula:



wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen;

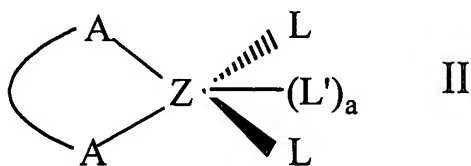
and each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/ transition metal complex, a tridentate ligand/transition metal complex and mixtures thereof and wherein the transition metal of said complex is Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr or Hf;

said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μ mol of transition metal per gram of inorganic oxide and a mole ratio of aluminum to transition metal of from 1:1 to 25:1.

134. (currently amended) The catalyst composition of Claim 133 wherein the transition metal compound is a bidentate ligand/transition metal complex represented by the formula



wherein

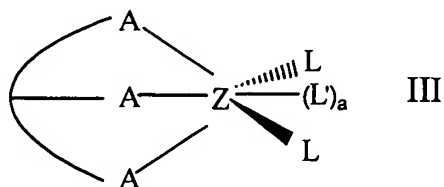
i) each A independently represents an oxygen, sulfur, phosphorus or nitrogen atom of the bidentate ligand;

ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr and Hf in the +2, +3 or +4 oxidation state;

iii) each L and L' independently represents an anionic ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z, represents a C₃-C₂₄ hydrocarbylene metallocyclic structure; and

iv) "a" of (L')_a is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

135. (currently amended) The catalyst composition of Claim 133 wherein the transition metal compound is a tridentate ligand/transition metal complex represented by the formula



wherein

- i) each A independently represents an oxygen, sulfur, phosphorous or nitrogen atom of a tridentate ligand;
- ii) Z represents a transition metal selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir and Pt in the +2 or +3 oxidation state and Ti, Zr, and Hf in the +2, +3 or +4 oxidation state;
- iii) each L and L' independently represents an anionic ligand group selected from the group consisting of hydrogen, halogen, an unsubstituted or a substituted hydrocarbon radical or both L, together with Z represents a C₃-C₂₄ hydrocarbylene metallocyclic structure; and
- iv) "a" of (L')_a is an integer of 0, 1 or 2 to provide a neutral transition metal complex.

136. (previously presented) The catalyst composition of claim 134 or 135 wherein each A represents a nitrogen atom, each L and L' is independently a halogen atom, or a hydrocarbyl or mixtures thereof or both L together form a hydrocarbylene metallocyclic group which, with Z, forms a 3 to 7 member ring structure.

137. (previously presented) The catalyst composition of Claim 134 or 135 wherein

"a" of the aluminum compound is 1 to 3 and each L of the transition metal compound is a halogen atom.

138. (previously presented) The catalyst composition of Claim 134 or 135 wherein at least one L of the transition metal complex is a hydrocarbyl.
139. (previously presented) The catalyst of Claim 136 wherein Z is Ni, Pd, Fe or Co.
140. (previously presented) The catalyst composition of Claim 134 wherein Z is Ni or Pd and each L is independently a chlorine, bromine, iodine or a C₁-C₈ alkyl group.
141. (previously presented) The catalyst composition of Claim 135 wherein Z is iron or cobalt and each L is independently a chlorine, bromine, iodine or a C₁-C₈ alkyl group.
142. (previously presented) The catalyst composition of Claim 133 wherein "a" of the aluminum compound is 3.
143. (previously presented) The catalyst composition of Claim 134 wherein "a" of the aluminum compound is 3.
144. (previously presented) The catalyst composition of Claim 135 wherein "a" of the aluminum compound is 3.
145. (previously presented) The catalyst composition of Claim 136 wherein "a" of the aluminum compound is 3.
146. (previously presented) The catalyst composition of Claim 133 wherein the transition metal is Fe.
147. (previously presented) The catalyst composition of Claim 134 wherein the transition metal is Fe.

148. (previously presented) The catalyst composition of Claim 135 wherein the transition metal is Fe.

149. (previously presented) The catalyst composition of Claim 142, 143 or 144 wherein the transition metal is Fe.

150. (previously presented) The catalyst composition of Claim 133 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

151. (previously presented) The catalyst composition of Claim 142 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

152. (previously presented) The catalyst composition of Claim 143 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

153. (previously presented) The catalyst composition of Claim 144 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

154. (previously presented) The catalyst composition of Claim 145 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

155. (previously presented) The catalyst composition of Claim 146 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

156. (previously presented) The catalyst composition of Claim 147 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

157. (previously presented) The catalyst composition of Claim 148 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

158. (previously presented) The catalyst composition of Claim 149 wherein the inorganic oxide has a total volatile content of 0.1 to about 4 weight percent, surface hydroxyl groups of from 0.1 to 5 mmol/g and a surface area of from 10 to 1000 m²/g.

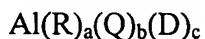
159. (previously presented) The catalyst composition of Claim 133, 142, 143, 144 or 150 wherein the inorganic oxide is silica and the transition metal is Fe.

160. (previously presented) The catalyst composition of Claim 133, 142, or 150 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

161. (previously presented) The catalyst composition of Claim 159 wherein said aluminum compound is present in an amount to provide from about 0.01 to 1.9 mmol of Al per gram of inorganic oxide; said transition metal complex is present in an amount to provide from 5 to 500 moles of transition metal per gram of inorganic oxide and said aluminum to transition metal is in a molar ratio of 1:1 to 20:1.

162. (previously presented) A process for forming a heterogeneous catalyst useful in the polymerization of olefins comprising contacting substantially simultaneously in a single reaction zone having an inert liquid, the components comprising:

a) aluminum compounds selected from at least one aluminum compound represented by the formula



wherein

R is a hydrocarbyl group;

Q is a hydrocarbyloxy group;

D is hydrogen or halogen; and

each a, b, c is an integer of 0-3 provided the sum of a+b+c is 3;

b) an inorganic oxide having from 0.01 to 12 mmole/gram of surface hydroxyl groups; and

c) a precatalyst selected from at least one transition metal compound selected from the group consisting of a bidentate ligand/transition metal complex, tridentate ligand/transition metal complex and mixtures thereof and wherein said transition metal is selected from the group consisting of Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt, Ti, Zr and Hf; said components being present in amounts to provide 0.001 to 2.1 mmol of aluminum and from 1 to 1000 μmol of transition metal per gram of inorganic oxide and a mole ratio of aluminum to transition metal of from 1:1 to 25:1.

163. (currently amended) The process of Claim 162 wherein the components a), b) and c) are ~~contacted substantially simultaneously~~concurrently introduced into the inert liquid and maintained therein at a temperature of from 0° to 50 °C and atmospheric pressure.

164. (previously presented) The process of Claim 162 or 163 wherein the transition metal is Fe.

165. (previously presented) The process of Claim 162 or 163 wherein the inorganic oxide is silica.

166. (previously presented) The process of Claim 165 wherein the transition metal is Fe.

167. (previously presented) The process of Claim 166 wherein “a” of the aluminum compound is 3.

168. (new) The process of Claim 162 wherein the components are introduced into the inert liquid in the order of first component a), followed by component b), and then followed by component c) and recovering a solid mixture from the liquid.